

**Increasing Community Resilience to  
Future Hurricane Storm Surge:  
Collaborative Decision Support in Sarasota, Florida**

*A project funded by the  
National Oceanic and Atmospheric Administration  
Climate Program Office  
Sectoral Applications Research Program*

**Principal Investigator**

**Brent Yarnal**  
Department of Geography &  
Center for Integrated Regional Assessment  
The Pennsylvania State University

**Co-Principal Investigator**

**Nathan J. Wood**  
U.S. Geological Survey

**Progress  
August 2007-May 2008**

The devastation along the Louisiana, Mississippi, and Alabama coasts resulting from Hurricane Katrina demonstrated the vulnerability of coastal communities to storm surge. Sea-level rise (SLR) increases that vulnerability significantly by exposing new parts of a community to potential storm surge inundation. Although progressive local governments account for hurricane storm surge in their planning, they neither account for SLR nor plan on the timescales of SLR projections.

Sea-level rise (SLR) is an important manifestation of climate change that not only is affecting the low-lying coastal communities of the Southeast United States today, but also will affect these communities centuries into the future. Especially worrisome is the prospect of future hurricane storm surge. The nearly 28-foot storm surge generated by Hurricane Katrina along the Mississippi coast was a compelling reminder of the potential devastating impact of this hazard along the Southeast coastline today. As great as the present danger is, past research demonstrated that SLR will enlarge future storm surge risk zones substantially.

SLR is not the only process making the Southeast's coastal communities more vulnerable to hurricane storm surge. Continued near-shore population growth and economic development increases the level of development and community assets in hazard-prone areas, thereby creating new risks.

Sarasota, Florida is an excellent case where growth and development will intersect with SLR to increase vulnerability to hurricane storm surge. Due to its desired coastal location and year-round climate, the area has experienced significant growth in recent years, resulting in rapid development. The rapidly growing area faces challenges of how to balance increasing population growth and development with the need to lower community vulnerability to natural hazards. Local goals of increased resilience, decreased vulnerability, and long-term sustainability are encouraging but—as demonstrated by the consequences of Hurricane Katrina—many coastal communities are unprepared for the devastation a storm surge of that magnitude generates. Increasing SLR will exacerbate the damage of such a storm surge through flooding that continually will reach further inland.

Accordingly, the goal of this research is to develop a methodology that helps local government officials and planners understand a range of options that allows coastal communities to grow and develop with less risk of significant loss from future hurricane storm surge. Consequently, this research project addresses several questions: (1) What are the societal vulnerabilities of Sarasota related to contemporary storm surge models, and what are the vulnerabilities to storm surge that SLR could bring to Sarasota in the future? (2) What impacts will population growth and increased development have on Sarasota's future vulnerability to hurricane storm surge as enhanced by SLR? (3) How can long-range planning that accounts for simultaneous SLR, population growth, and development help make Sarasota more resilient to storm surge in the future?

The following report discusses progress made in the first ten months of the research. Topics covered include research activities, preliminary insights, interactions with stakeholders, and presentations and publications. The report concludes with research objectives for the remainder of Year 1 and for Year 2 of the project.

### ***Research Activities***

There were several important research activities in the first ten months of the project.

- We made contact with federal, state, county, and municipal officials and obtained data essential for Phases 1 and 2 of the research project. Phases 1 and 2 consist of using geographic information system (GIS) tools to integrate various data (including residents, business, employees, critical facilities and infrastructure, and land use land cover) and hazard data (including SLOSH and SLR enhanced SLOSH output).
- We modeled the effect of SLR on the hurricane storm surge inundation zones for Sarasota County. This was accomplished by taking the SLOSH surge zones (category 1, 2, 3, 4-5 on the Saffin-Simpson hurricane scale) and extending each of those 30, 60, 90, and 120 cm creating sixteen different polygons that account for projected SLR enhanced hurricane storm surge.
- We visited Sarasota County and met with stakeholders from knowledge domains essential to our project, including the President of the Chamber of Commerce, a marine engineer who is a local leader on hazards reduction, the county emergency manager and a member of his staff, the county Environmental Administrator, a regional planner with

expertise in hurricane storm surge, a member of the governor's task force on climate change, and the Vice-Mayor of Sarasota. The visit allowed us to gauge the climate of the community in terms of their initial reactions to our work, and better enabled us to estimate the level of participation we might expect for our upcoming focus groups. We also used the visit to begin recruiting focus group participants.

- We completed the ground truthing of critical facilities data. An accurate assessment of the location of critical facilities and infrastructure is essential as it allows our research to better approximate which specific facilities, or aspects of infrastructure, are likely to be affected by contemporary and SLR enhanced storm surge. A partial list of the type of critical facilities ground truthed includes hospitals, fire and police stations, physician's offices, water distribution and treatment facilities, and public utilities. For all, we used a GPS to verify the location of approximately 400 critical facilities in Sarasota County.
- We completed a socio-demographic and tax parcel analysis for all hazard zones in Sarasota County. The socio-demographic analysis allows us to determine the locations and characteristics of populations in relationship to the hazard zones. The tax parcel analysis enables us to determine the percentage of a municipality's tax base potentially exposed to a hazard in the various storm surge zones. A municipality's tax base is critical for both short and long term recovery post disaster.

### ***Preliminary Insights***

Preliminary insights indicate that with SLR the hazard zones increase considerably, putting significantly greater amounts of Sarasota County residential and employee populations at risk if no mitigation occurs for the locations of sensitive categories before disaster strikes (Figures 1-4).



Figure 1: Category 1 plus SLR

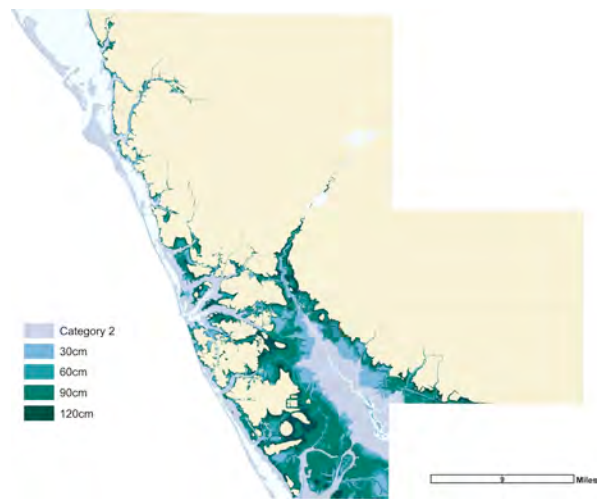


Figure 2: Category 2 plus SLR

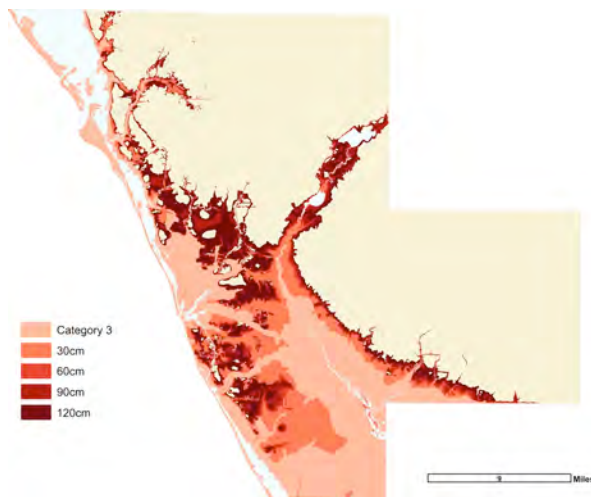


Figure 3: Category 3 plus SLR

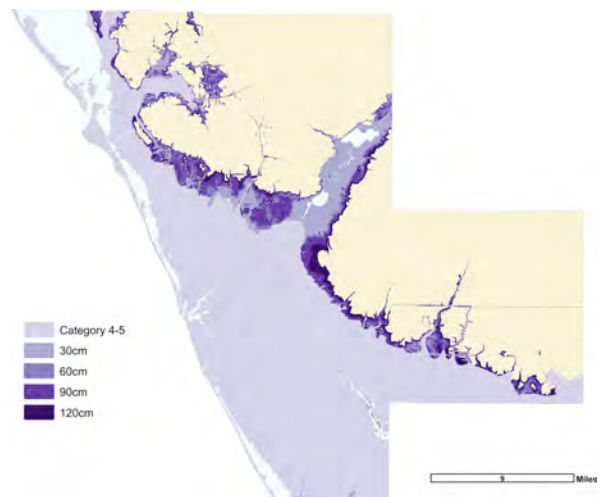


Figure 4: Category 4-5 plus SLR

Early project insights also indicate that a large proportion of Sarasota County's residential and employee populations are in the current storm surge hazard zones and many more are within future storm surge zones based on modeling that incorporates 30, 60, 90 and 120 cm rises in sea level. A high percentage of residents in both the current and future storm surge zones are older populations that may have difficulties evacuating and recovering from a hurricane. A large number and high relative percentage of employees and business in the numerous municipalities are also in the storm surge zones. Virtually all of the development in central and northern Sarasota County is located west of Interstate 75, which appears to serve as an imaginary boundary to hurricane storm surge inundation. In southern Sarasota County, much of the new development appears to be within the category 3 plus 120 cm of SLR-enhanced surge zone. Early insights indicate that county sustainable development policy, which has as a goal to restrict development west of I-75, may have the unintended consequence of constraining residential and economic development to within the hazard zones. Thus, at least from a hazard mitigation perspective, promoting urban sprawl away from the coast may in fact offer a more resilient and sustainable long-term development option for Sarasota County and similarly developed coastal communities.

### ***Publications and Presentations***

The preliminary findings have provided the research team with the opportunity to produce a peer-reviewed conference publication and a formal presentation early in the project. The presentation was given at the American Society of Civil Engineers (ASCE) Solutions to Coastal Disasters conference in April 2008. The citation for the publication is:

Frazier, T., N. Wood, B. Yarnal, 2008, Current and Future Vulnerability of Sarasota County, Florida, to Hurricane Storm Surge and Sea Level Rise. *Proceedings of the Solutions to Coastal Disasters Conference*, Turtle Bay, HI.

In addition, because of work on this project, the PI was invited to serve as a moderator/facilitator at the conference titled, “Global Climate Change and Sea-Level Rise in Florida: A Conversation Between Scientists and the Media,” hosted by the University of South Florida–St. Petersburg in February 2008.

### ***Year 2 Research Objectives***

We are poised to make major advances in the remaining months of Year 1. Those advances will lead directly to the Year 2 activities. Additional Year 1 work includes focus groups and interviews with stakeholders to determine future development patterns and land use plans, assessment of vulnerability based on SLR-enhanced storm surge and future land use scenarios, and evaluation of the overall research process. Focus groups with stakeholders—consisting of, planners, public works personnel, developers, business owners, emergency management personnel, and elected officials—will take place in July 08. Focus group members will use paper copies of maps to create development scenarios for Sarasota County both with and without SLR. The resulting data will be in transcript and map format; the transcripts will be analyzed using qualitative data analysis software (e.g., ATLAS.ti) for recurring themes, and the sketch maps of future land use and economic and demographic patterns will be used to create a series of spatial projections of future growth and development. This information will be interpreted to develop an understanding of the experts’ collective viewpoints. When scenarios of development have been established, GIS tools will be used to provide spatial overlays of storm surge-enhanced SLR to determine areas where flooding is likely to occur so as to allow recommendations to steer development to areas less likely to be inundated.

Year 2 activities will include a future storm surge vulnerability analysis given the scenarios of future socioeconomic change developed by the focus group meetings with project participants and stakeholders, which will be completed in fall 2008. Year 2 research will also consist of follow-up interviews to evaluate the effectiveness of the collaborative process and the utility of employing SLR scenarios to guide development in Sarasota County. These follow-up interviews are set to occur spring 2009. The evolving project time line can be seen in Figure 5.

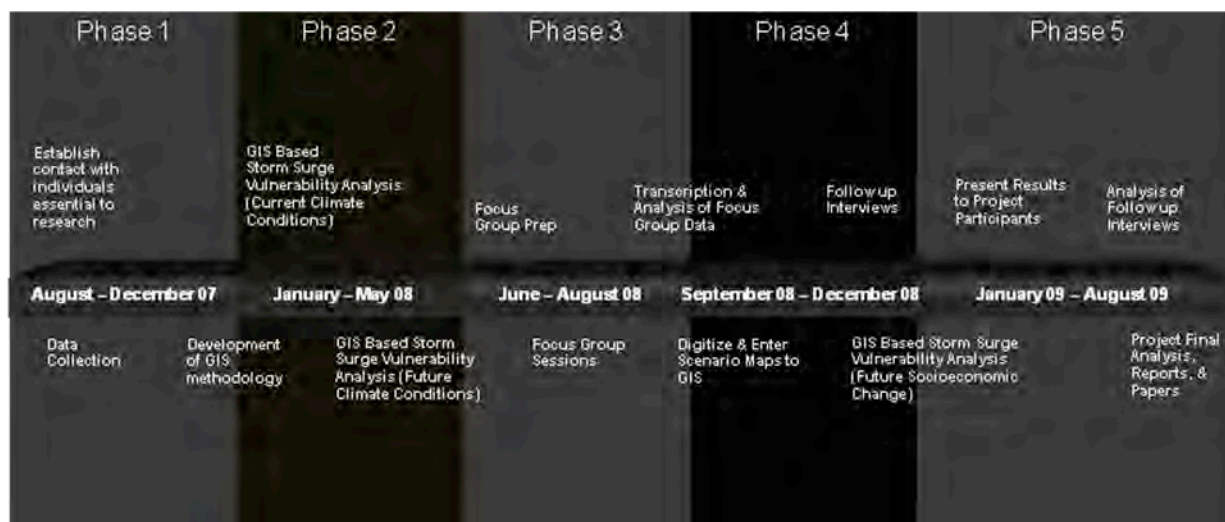


Figure 5. Project time line